

# PATENT COOPERATION TREATY

From the  
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

## PCT

### NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Rule 71.1)

To:

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Date of mailing  
(day/month/year)

14.02.2005

Applicant's or agent's file reference  
E-1950-03

#### IMPORTANT NOTIFICATION

International application No.  
PCT/EP 03/51022

International filing date (day/month/year)  
16.12.2003

Priority date (day/month/year)  
16.12.2002

Applicant  
UNIVERSITA' DI PISA et al.

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international application.
2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.
3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.
4. **REMINDER**

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

The applicant's attention is drawn to Article 33(5), which provides that the criteria of novelty, inventive step and industrial applicability described in Article 33(2) to (4) merely serve the purposes of international preliminary examination and that "any Contracting State may apply additional or different criteria for the purposes of deciding whether, in that State, the claimed inventions is patentable or not" (see also Article 27(5)). Such additional criteria may relate, for example, to exemptions from patentability, requirements for enabling disclosure, clarity and support for the claims.

Name and mailing address of the international  
preliminary examining authority:



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# PATENT COOPERATION TREATY

## PCT

### INTERNATIONAL PRELIMINARY EXAMINATION REPORT (PCT Article 36 and Rule 70)

Applicant's or agent's file reference E-1950-03		<b>FOR FURTHER ACTION</b> See Notification of Transmittal of International Preliminary Examination Report (Form PCT/PEA/416)	
International application No. PCT/EP 03/51022		International filing date (day/month/year) 16.12.2003	Priority date (day/month/year) 16.12.2002
International Patent Classification (IPC) or both national classification and IPC B60K6/04			
Applicant UNIVERSITA' DI PISA et al.			
<p>1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 6 sheets, including this cover sheet.</p> <p><input checked="" type="checkbox"/> This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).</p> <p>These annexes consist of a total of 7 sheets.</p>			
<p>3. This report contains indications relating to the following items:</p> <p>I <input checked="" type="checkbox"/> Basis of the opinion</p> <p>II <input type="checkbox"/> Priority</p> <p>III <input type="checkbox"/> Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</p> <p>IV <input type="checkbox"/> Lack of unity of invention</p> <p>V <input checked="" type="checkbox"/> Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</p> <p>VI <input type="checkbox"/> Certain documents cited</p> <p>VII <input type="checkbox"/> Certain defects in the international application</p> <p>VIII <input type="checkbox"/> Certain observations on the international application</p>			
Date of submission of the demand  09.07.2004		Date of completion of this report  14.02.2005	
Name and mailing address of the international preliminary examining authority:  European Patent Office - Gitschiner Str. 103 D-10958 Berlin Tel. +49 30 25901 - 0 Fax: +49 30 25901 - 840		Authorized Officer  Călămar, G  Telephone No. +49 30 25901-505	



**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT**

International application No. PCT/EP 03/51022

**I. Basis of the report**

1. With regard to the **elements** of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)*):

**Description, Pages**

1, 2, 5-12 as originally filed  
3, 4, 4a received on 24.12.2004 with letter of 24.12.2004

**Claims, Numbers**

1-15 received on 24.12.2004 with letter of 24.12.2004

**Drawings, Sheets**

1/2-2/2 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).  
☐ the language of publication of the international application (under Rule 48.3(b)).  
☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.  
☐ filed together with the international application in computer readable form.  
☐ furnished subsequently to this Authority in written form.  
☐ furnished subsequently to this Authority in computer readable form.  
☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.  
☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:  
☐ the claims, Nos.:  
☐ the drawings, sheets:

**INTERNATIONAL PRELIMINARY  
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5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)).

*(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)*

6. Additional observations, if necessary:

**V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

1. Statement

Novelty (N)	Yes: Claims	8
	No: Claims	1-7,9-15
Inventive-step (IS)	Yes: Claims	8
	No: Claims	1-7,9-15
Industrial applicability (IA)	Yes: Claims	1-15
	No: Claims	

2. Citations and explanations

**see separate sheet**

**Re Item V**

**Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

1 Reference is made to the following documents:

D1: EP0908343 A

D2: EP0445873 A

2 The present application does not meet the criteria of Article 33(1) PCT, because the subject-matter of claims 1-7 and 9-15 does not involve an inventive step in the sense of Article 33(3) PCT.

2.1 With respect to claim 1, D1 discloses (the references in parentheses applying to this document): a hybrid drive assembly (Figure 1) for a vehicle having at least one drive wheel (implicit), the drive assembly comprising an internal combustion engine (1); and a transmission unit (11) interposed between a drive shaft (1a) of the internal combustion engine (1) and a propeller shaft (15) connected angularly to the drive wheel (Figure 1), and in turn comprising a clutch (6) and a transmission having a drive element (7) connected angularly to the drive shaft (1a) of the internal combustion engine (1) and a driven element (9) connectable to said propeller shaft (15); the drive assembly further including an electric machine (2) which can be operated instead of or in combination with said internal combustion engine (Abstract), said electric machine (2) comprises a rotor (2a) connected angularly and permanently to said driven member of said clutch (Figure 1) from which the subject-matter of claim 1 differs in that the clutch (6) is interposed between said driven element (9) of said transmission (11) and said propeller shaft (15) and has a drive member connectable to said driven element of said transmission and a driven member connected to the propeller shaft.

The problem to be solved by the present invention may therefore be regarded as providing a compact assembly.

Feature "clutch is interposed between said driven element of said transmission and said propeller shaft and has a drive member connectable to said driven element of said transmission and a driven member connected to the propeller shaft" is described in D2 as providing the same advantages as in the present application (Figure 1). The skilled person would therefore regard it as a normal

option to include this feature in D1 in order to solve the problem posed.

- 2.2 The same reasoning applies *mutatis mutandis* to the subject-matter of the corresponding independent claim 14, which therefore is also considered not inventive.

Thus, claims 1 and 14 are not inventive.

- 2.3 Referring to claim 2, D1 discloses that the transmission unit comprises a CVT (11) having a drive pulley (7) connected angularly to the drive shaft (1b) of the internal combustion engine (1) and a driven pulley connectable to the hub of the clutch (Figure 1, implicit).
- 2.4 With respect to claim 3, D2 discloses a drive assembly in which a centrifugal clutch is provided, said driven member of said clutch being a bell integral with said propeller shaft (Column 2, lines 48-51).
- 2.5 Regarding claim 4, D1 discloses that the rotor (2a) of said electric machine (2) is coaxial and integral with said bell of said clutch (6).
- 2.6 Referring to claims 5, 7, 12 und 13 the features of these claims are merely several straightforward possibilities from which the skilled person would select, in accordance with circumstances, without any exercise of inventive skill.
- 2.7 With regard to claim 6, D1 discloses a coupling interposed between said drive shaft and said drive member ([0039]).
- 2.8 Referring to claim 9, D1 discloses an electric generator (2) driven by said internal combustion engine (1).
- 2.9 With respect to claim 10, D2 discloses a drive assembly where there are provided operating modes comprising at least a combustion mode wherein only the internal combustion engine is activated, an electric mode wherein said electric machine operates as a motor and said internal combustion engine is disabled, a parallel hybrid mode wherein said internal combustion engine and said electric machine are both activated and connected to said drive wheel, and a series hybrid mode wherein said internal combustion engine is disconnected from said drive wheel and drives said electric generator (Column 1, lines 45-50).

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT - SEPARATE SHEET**

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International application No. PCT/EP 03/51022

- 2.10 The subject-matter of claim 11 is also considered not to be inventive, whereby the features of this claim are disclosed in D2 (Column 1, lines 45-50, implicit).
- 2.11 Dependent claim 15 does not contain any features which, in combination with the features of any claim to which it refers, meet the requirements of the PCT in respect of novelty and/or inventive step.
- 2.12 The combination of the features of dependent claim 8 is neither known from, nor rendered obvious by, the available prior art.

10/538317

JC20 Rec'd PCT/PTO 13 JUN 2005

In the "parallel hybrid" configuration, both the combustion engine and the electric motor are connected to the drive wheels by appropriate transmission mechanisms.

Known hybrid drive assemblies of the type briefly described above are complex, expensive, and bulky, which is why, to the Applicant's knowledge, they have never been marketed for compact, low-cost vehicles, such as scooters.

EP-A-0 908 343 discloses a hybrid drive assembly including an internal combustion engine having a drive shaft, an electric machine having a rotor connected to a primary shaft aligned to the engine drive shaft, a clutch interposed between the engine drive shaft and the electric machine rotor, and a transmission unit including a CVT interposed between the primary shaft and the wheel axle.

Besides being considerably complex and thus not adapted for use in small road vehicles such as scooters, the above-referenced known hybrid drive assembly has a drawback in that the electric machine is located upstream from the transmission unit, and in particular the CVT, so that, when the electric machines operates as a generator (regenerative brake), energy recovery efficiency is reduced.

#### DISCLOSURE OF INVENTION

It is an object of the present invention to provide an extremely straightforward, low-cost, compact hybrid drive assembly, which can also be used in small, low-cost



road vehicles, such as scooters, but which also permits selection of a number of operating modes on the basis of different operating requirements or road conditions.

According to the present invention, there is  
5 provided a hybrid drive assembly for a vehicle having at least one drive wheel, the drive assembly comprising an internal combustion engine; and a transmission unit interposed between a drive shaft of the internal combustion engine and a propeller shaft connected  
10 angularly to the drive wheel, and in turn comprising a clutch and a transmission having a drive element connected angularly to the drive shaft of the internal combustion engine and a driven element connectable to said propeller shaft; the drive assembly further  
15 including an electric machine which can be operated instead of or in combination with said internal combustion engine, characterised in that said clutch is interposed between said driven element of said transmission and said propeller shaft, and has a drive  
20 member connectable to said driven element of said transmission and a driven member connected to the propeller shaft, said electric machine comprising a rotor connected angularly and permanently to said driven member of said clutch.

~~comprises a rotor connected angularly and permanently to  
said driven member of said clutch.~~

The present invention also relates to a vehicle, in particular a scooter, comprising such a hybrid drive  
5 assembly.

#### BRIEF DESCRIPTION OF THE DRAWINGS

Two preferred, non-limiting embodiments of the present invention will be described by way of example with reference to the accompanying drawings, in which:

10 Figure 1 shows a diagram of a hybrid drive assembly in accordance with a first embodiment of the invention;

Figure 2 shows a diagram of a control system for controlling the Figure 1 drive assembly;

15 Figure 3 shows a partial diagram of an alternative embodiment of the present invention.

#### BEST MODE FOR CARRYING OUT THE INVENTION

Number 1 in Figure 1 indicates as a whole a hybrid drive assembly for a scooter having a rear drive wheel 2 of axis A.

20 Drive assembly 1 comprises a combustion engine 3 having a drive shaft 4 of axis B parallel to axis A; and a transmission unit 5 interposed between drive shaft 4 and a propeller shaft 6 of axis C, parallel to axes A and B, and connected angularly to the drive wheel 2.

25 More specifically, transmission unit 5 comprises a continuously variable transmission or CVT 7 (hereinafter referred to simply as "CVT 7"), and a centrifugal clutch 8 in series with each other.

## CLAIMS

1) A hybrid drive assembly (1) for a vehicle having at least one drive wheel (2), the drive assembly comprising an internal combustion engine (3); and a transmission unit (5) interposed between a drive shaft (4) of the internal combustion engine (3) and a propeller shaft (6) connected angularly to the drive wheel (2), and in turn comprising a clutch (8) and a transmission (7) having a drive element (10) connected angularly to the drive shaft (4) of the internal combustion engine (3) and a driven element (11) connectable to said propeller shaft (6); the drive assembly (1) further including an electric machine (32) which can be operated instead of or in combination with said internal combustion engine (3), **characterised in that** said clutch (8) is interposed between said driven element (11) of said transmission and said propeller shaft (6), and has a drive member (20) connectable to said driven element (11) of said transmission (7) and a driven member (26) connected to the propeller shaft (6), said electric machine (32) comprising a rotor (35) connected angularly and permanently to said driven member (26) of said clutch (8).

2) A drive assembly as claimed in Claim 1, characterized in that said transmission (7) is a CVT, said drive element (10) and driven element (11) consisting of a drive pulley (10) and, respectively, a

driven pulley (11) of said CVT.

3) A drive assembly as claimed in Claim 1 or 2, characterized in that said clutch (8) is a centrifugal clutch; said driven member of said clutch (8) being a  
5 bell (26) integral with said propeller shaft (6).

4) A drive assembly as claimed in Claim 3, characterized in that said rotor (35) of said electric machine (32) is coaxial and integral with said bell (26) of said clutch (8).

10 5) A drive assembly as claimed in any one of the foregoing Claims, characterized in that said electric machine (32) is reversible.

6) A drive assembly as claimed in one of the foregoing Claims, characterized by comprising a coupling  
15 (51) interposed between said drive shaft (4) and said drive member (20) of said clutch (8).

7) A drive assembly as claimed in Claim 6, characterized in that said coupling (51) is controlled electromagnetically.

20 8) A drive assembly as claimed in Claim 6 or 7, when dependent on one of Claims 2 to 5, characterized in that said coupling (51) is interposed between said driven pulley (11) and said drive member (20) of said clutch (8).

25 9) A drive assembly as claimed in any one of the foregoing Claims, characterized by comprising an electric generator (37) driven by said internal combustion engine (3).

10) A drive assembly as claimed in any one of the foregoing Claims, characterized by comprising a control unit (38) for controlling said internal combustion engine (3) and said electric machine (32), in response to a number of input signals (Sa, Sf, Ss), in a number of operating modes comprising at least a combustion mode wherein only the internal combustion engine (3) is activated, an electric mode wherein said electric machine (32) operates as a motor and said internal combustion engine (3) is disabled, a parallel hybrid mode wherein said internal combustion engine (3) and said electric machine (32) are both activated and connected to said drive wheel (2), and a series hybrid mode wherein said internal combustion engine is disconnected from said drive wheel (2) and drives said electric generator (37).

11) A drive assembly as claimed in Claim 10, characterized by comprising selecting means (46) for selecting said operating modes of said drive assembly (1); said input signals (Sa, Sf, Ss) comprising at least a number of input signals (Ss) generated by said selecting means (46).

12) A drive assembly as claimed in Claim 10 or 11, characterized in that said input signals (Sa, Sf, Ss) comprise a signal (Sa) indicating the position of an accelerator member (44).

13) A drive assembly as claimed in one of Claims 10 to 12, characterized in that said input signals (Sa, Sf, Ss) comprise a signal indicating actions on a brake

control member (45) of the vehicle.

14) A vehicle having at least one drive wheel (2), characterized by comprising a hybrid drive assembly (1) as claimed in any one of the foregoing Claims.

5        15) A vehicle as claimed in Claimed 14, characterized by being a scooter.